California Regional Water Quality Control Board
North Coast Region
Bob Anderson, Chairman

Linda S. Adams
Secretary for Environmental Protection

www.waterboards.ca.gov/northcoast
5550 Skylane Boulevard, Suite A, Santa Rosa, California 95403
Phone: (877) 721-9203 (toll free) • Office: (707) 576-2220 • FAX: (707) 523-0135

Arnold Schwarzenegger
Governor

November 7, 2008

Dr. Gerald Bowes
Department of Water Quality
State Water Resources Control Board
Post Office Box 100
Sacramento, California 95812-0100

Subject: Request for External Peer Reviewers of the Scientific Basis of the Proposed BPA for the Klamath River Dissolved Oxygen, Nutrient, Organic Matter and Temperature TMDL Action Plan

Dear Dr. Bowes:

In accordance with Section 57004 of the California Heath and Safety Code, the North Coast Regional Water Quality Control Board (Regional Water Board) is requesting external scientific peer review of the scientific basis of a proposed amendment to the *Water Quality Control Plan for the North Coast Region* (Basin Plan). The proposed Basin Plan amendment (BPA) will incorporate the Action Plan for the Klamath River Dissolved Oxygen, Nutrient, Organic Matter and Temperature Total Maximum Daily Loads (TMDL), supported by the TMDL Staff Report.

The Klamath River is a bi-state watershed, and the TMDL development analysis has been conducted jointly between staff of the Regional Water Board and the Oregon Department of Environmental Quality, with support from US EPA Regions 9 and 10. This request for external peer review is only for the Regional Water Board's Klamath River TMDL Staff Report. The Klamath River has received wide spread attention over the past eight years due to: 1) reductions in water deliveries for agricultural irrigation Interior in 2001 ordered by the Department of Interior; 2) the death of at least 34,000 adult salmonids in the fall of 2002; and 3) consideration of the terms for relicensing of the Klamath Hydroelectric Project dams on the Klamath River in Oregon and California.

Purpose of the Request

The purpose of this letter is to request external scientific peer reviewers of the Staff Report for the proposed Klamath River TMDL Action Plan, the methodology and data used in its development, and the recommended load reductions required to fully support beneficial uses. This request provides an overview of the amendment and scientific issues in order to facilitate selection of external peer reviewers.

Expected Date of Regional Board Action

The Regional Water Board is expected to formally consider the proposed amendment during its scheduled meeting in September 2009. Final approval by US EPA of the Klamath River TMDLs is required by December 2010 pursuant to the terms of a court ordered consent decree schedule. In order to meet this schedule, we request receipt of the peer reviewer's comments by February 1, 2009.

Expected Date the Documents will be Available for Review
November 21, 2008

Requested Review Period
As stated above, in order to meet the court ordered schedule for EPA adoption of the proposed amendment, we request receipt of the peer reviewer's comments by February 1, 2009. We recognize that the normal review period is thirty (30) days; however, we would allow a forty-five (45) day review period should peer reviewers be selected early enough.

Suggested Areas of Expertise for Reviewers
The proposed amendment is comprehensive and encompasses numerous disciplines. We suggest that having up to four reviewers with varying expertise is appropriate for this project. Reviewers should have expertise in the following fields:

- Water quality modeling: particular emphasis on water temperature, nutrient and organic enrichment, and low dissolved oxygen (DO) in riverine, reservoir, and estuarine environments.
- Water chemistry and limnology: particular emphasis on the physical, chemical, and biological factors influencing temperature, nutrients, and DO in productive riverine, reservoir, and estuarine environments.
- Fisheries biology: with a focus on the freshwater habitat (physical and chemical) needs of salmonid species.
- Restoration ecology: particular emphasis on land use practices (e.g. silviculture, grazing, irrigated agriculture) and water quality protection measures.

Contact Information
Matt St. John: MstJohn@waterboards.ca.gov (707) 570-3762, is the project manager.

Attached please find (1) a plain English summary of the proposed amendment, (2) a list of focused scientific topics for the peer reviewers, and (3) a list of scientists involved in development of the draft document.

Please contact me if you have questions. Thank you for your assistance.

Sincerely,

Matt St. John
Lead, TMDL Unit

Attachments

Attachment 1

Description of Proposed Action

INTRODUCTION

The North Coast Regional Water Quality Control Board (Regional Water Board) is proposing an amendment to the *Water Quality Control Plan for the North Coast Region* (Basin Plan) titled the Action Plan for the Klamath River Dissolved Oxygen, Nutrient, Organic Matter and Temperature Total Maximum Daily Loads (TMDL), hereinafter known as the TMDL Action Plan. The TMDL Action Plan will:

- Evaluate current conditions in the watershed with respect to dissolved oxygen and in-stream water temperature,
- Establish a causal linkage between pollutant sources and loads on water quality conditions,
- Present in-stream metrics that represent properly functioning conditions,
- Establish load allocations for constituents and conditions affecting dissolved oxygen and temperature, and
- Present an implementation plan which describes required actions and activities necessary to achieve the TMDLs.

BACKGROUND

The Klamath River basin is 12,680 square miles originating in southern Oregon and flowing through northern California entering the Pacific Ocean at Requa in Del Norte County. Forty-four (44%) percent of the watershed lies within the boundaries of Oregon while the remaining lies within the boundaries of California. The Klamath River basin is of vital economic and cultural importance to both Oregon and California as well as to the Klamath Tribes in Oregon, and the Hoopa, Karuk, and Yurok Tribes, Quartz Valley Indian Reservation and the Resighini Rancheria in California. Two-thirds (2/3) of the watershed is under federal ownership including National Forests, Wildlife Refuges and Parks, and the Bureau of Reclamation.

Fertile lands provide for a rich agricultural economy in the upper basin. Irrigation facilities known as the Klamath Project owned by the U.S. Bureau of Reclamation support this economy, as well as hydroelectric power provided via a system of five (5) dams operated by PacifiCorp. The PacifiCorp facilities are currently undergoing licensure review by the Federal Energy Regulatory Commission. The Klamath River basin is the home spawning grounds of a once vast tribal, sport, and commercial fishery, and provides other aquatic resources of cultural significance to the local Indian tribes. The watershed supports an active recreational industry, including activities that are specific to the Wild and Scenic portions of the river designated by both the states and federal governments in both Oregon and California. The watershed also continues to support what were once historically significant mining and timber industries.

Impairments to water quality have been identified as one of the factors contributing to the continued decline of native fish populations. This has led to water quality assessments by the States of Oregon and California and the listing of the Klamath River as an impaired waterbody under Section 303(d) of the Clean Water Act. In the Klamath River in California increased water temperatures, elevated nutrients, organic enrichment, sedimentation and the presence of blue-

green algae toxins have decreased the quality and quantity of suitable habitat for cold water aquatic life (specifically the salmonid fishery), and have disrupted cultural uses of the river by resident Tribes. Reaches of the Klamath River in Oregon are identified as impaired for temperature, dissolved oxygen, pH, ammonia, and chlorophyll-a. The States of Oregon and California are responsible for calculating the total maximum daily load of each of the pollutants of concern that can be discharged to the river and still protect the fisheries and other beneficial uses of the water within their respective jurisdictions. These calculations are otherwise known as TMDLs (Total Maximum Daily Loads). In California a TMDL also includes an Implementation Plan, which, when adopted by the Regional and State Board and approved by EPA, becomes the regulatory framework for attaining and maintaining water quality standards. Regional Water Board staff are working jointly with staff of the Oregon Department of Environmental Quality (ODEQ) and US EPA Regions 9 and 10 in developing TMDLs for the Klamath River. A unified technical analysis supports separate TMDLs for the Klamath River for each state.

The water quality conditions and impacts that are addressed in the TMDL staff report are summarized below:

- Nutrient concentrations in much of the Klamath River watershed are well above natural background levels and contribute to excess periphyton and phytoplankton growth, which in turn contributes to poor DO and pH conditions, and also contributes to increased abundance and exposure of fish to parasites (i.e., *Ceratomyxa shasta*).

- Conditions of low DO and high pH are persistent in much of the Klamath River and contribute to multiple impacts on cold water fisheries including: migration barriers, decreased growth and fecundity, decreased reproductive success, increased juvenile fish mortality, increased adult mortality, and lower overall fish populations.

- High levels of nutrients and the presence of impoundments have contributed to the development of nuisance levels of blue-green algae that have created potential health hazards for people exposed to reservoir and downstream river waters. This health hazard has negatively impacted both recreational and ceremonial use of the reservoirs and the river.

- Temperature conditions that exceed natural levels exist throughout the Klamath River basin and contribute to: chronic stress and sometimes acute lethal conditions for cold water fisheries, proliferation of fish diseases such as *Columnaris*, presence of migration barriers, lower reproductive success, increased juvenile and adult mortality, and lower overall fish populations.

- Excess sediment delivery to the Klamath River and tributary streams has contributed to habitat impairment, increased levels of nutrients, and contributed to the development of water column temperatures that exceed Basin Plan water quality objectives.

- Reduced tributary flows have led to increased water column temperatures, which have contributed to impacts on aquatic life.

- Water quality objectives for temperature, DO, pH, biostimulatory substances, and toxicity are regularly exceeded in the Klamath River basin in California.

The TMDL Implementation Plan will address such factors as: wetlands restoration/protection, reservoir operations, managment of rural/forest roads, irrigation and frarming practices, point source discharges, grazing, and water use. The Implementation Plan will contain:

- A description of the legal and regulatory controls available to the Regional Water Board and ODEQ to ensure that adequate and timely implementation of the TMDL occurs.
- A description of the implementation actions and management measures necessary to meet the TMDL load allocations and restore the beneficial uses of water in the Klamath River.
- A time line for implementing the identified management measures.
- A monitoring plan for tracking compliance with the TMDL management measures and progress toward meeting TMDL load allocations and water quality targets.
- An adaptive management component that requires the TMDL to be periodically revisited and updated based on documented progress towards TMDL compliance.

Attachment 2

Description of Issues to be Addressed by Peer Reviewers

The statutory mandate for external scientific review (Health and Safety Code Section 57004) states that it is the reviewer's responsibility to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices.

We request that the reviewer make this determination for each of the following issues that constitute the scientific portion of the proposed regulatory action. An explanatory statement is provided for each issue.

1. **Nutrient and chlorophyll a allocations to reservoirs developed to control blue-green algae blooms, associated toxins, and protect recreation and cultural beneficial uses.**

   Water quality models, such as the U.S. Army Corps of Engineers' CE-QUAL-W2 and Resource Management Associates (RMA) RMA-2 and RMA-11 applied to development of the Klamath River TMDLs, are able to simulate the state variable phytoplankton. These models are relatively simplistic, however, and treat phytoplankton as a single species. These models are not capable of predicting concentrations of varying types of algae species, i.e. they do not differentiate between greens, blue-greens, or diatoms. Further, to the best of our knowledge, no water quality models have been developed which simulate the production and decay of algal toxins, such as microcystin.

   The Klamath River was identified on the federal 303(d) List for elevated nutrients, organic enrichment/low dissolved oxygen (DO), and elevated water temperatures in the 1990s. These are the water quality impairments for which the subject TMDLs were developed. In March 2008, the USEPA added the reach of the Klamath River that incorporates Copco 1 and 2 and Iron Gate Reservoirs to the 303(d) List for the blue-green algae toxin microcystin. Due to the analytic (i.e. modeling) limitations for assessing algal toxins, and given the consent decree schedule for completing the nutrient, DO, and temperature TMDLs, Regional Water Board staff are not attempting to complete a microcystin TMDL at this time. However, staff believe the allocations included in the draft TMDL will substantially address control of the microcystin impairment.

   The draft TMDL includes the following nutrient-related load allocations to Copco 1 and 2 and Iron Gate Reservoirs:
   - Zero nutrient loading from reservoir bottom sediments;
   - 10 µg/L chlorophyll *a*, measured as a summer mean from water samples collected within the photic zone of the reservoirs.

   These allocations are designed in part to control blue-green algae blooms and reduce the public health risks associated with exposure to harmful concentrations of algal toxins. However, the load allocations to Copco 1 and 2 and Iron Gate Reservoirs do not require nutrient and organic matter reductions from upstream sources. Additional nutrient and organic matter (measured as carbonaceous biochemical oxygen demand [CBOD]) load allocations are set at Stateline. The load allocations set at Stateline are consistent with the water quality conditions that meet standards at the Stateline, and represent the cumulative load and waste load allocations included in Oregon Department of Environmental Quality's Klamath River TMDL.

The zero nutrient loading from reservoir bottom sediments load allocation to Copco 1 and 2 and Iron Gate Reservoirs is designed to attribute responsibility to these facilities for the contribution of inorganic nutrients to the water column under stratified anoxic reservoir conditions.

The 10 µg/L chlorophyll *a* load allocation to Copco 1 and 2 and Iron Gate Reservoirs was selected based on a risk assessment approach, whereby chlorophyll *a* concentrations greater than 10 µg/L can result in algal bloom conditions in which blue-green algae species, such as *Microcystis aeruginosa*, outcompete green and diatom species of algae.

Are these nutrient-related allocations to Copco 1 and 2 and Iron Gate Reservoirs based upon sound scientific knowledge, methods, and practices?

2. **Temperature and dissolved oxygen allocations to Copco and Iron Gate Reservoirs developed to support salmonid beneficial uses.**

Cold freshwater habitat (COLD), Spawning, reproduction, and/or early development (SPWN), and Migration of aquatic organisms (MIGR) are identified as existing beneficial uses within Copco and Iron Gate Reservoirs in the California Regional Water Board's *Water Quality Control Plan for the North Coast Region* (Basin Plan). Currently fish ladders are not present on Iron Gate Dam and Copco 1 and 2 Dams, and no anadromous salmonids currently inhabit the Klamath River upstream of Iron Gate Dam. However, both the US Fish and Wildlife Service and National Oceanic and Atmospheric Administration Fisheries have required that fish ladders be installed on both California dams, should the Federal Energy Regulatory Committee issue the facilities a new license to operate (the facilities are currently operating under a 1-year license extension).

The draft TMDL includes dual temperature and DO allocations for waters within Copco 1 and 2 and Iron Gate, wherein achievement of the water quality objective for temperature is dependent on dissolved oxygen conditions and vice versa. Allocations for dissolved oxygen and temperature are equal to a "compliance lens" where both DO and temperature conditions meet Basin Plan objectives for water temperature and DO and are therefore protective of the beneficial uses COLD and MIGR.

The concept of the compliance lens where both DO and temperature objectives are met is illustrated in Figure 1, below.

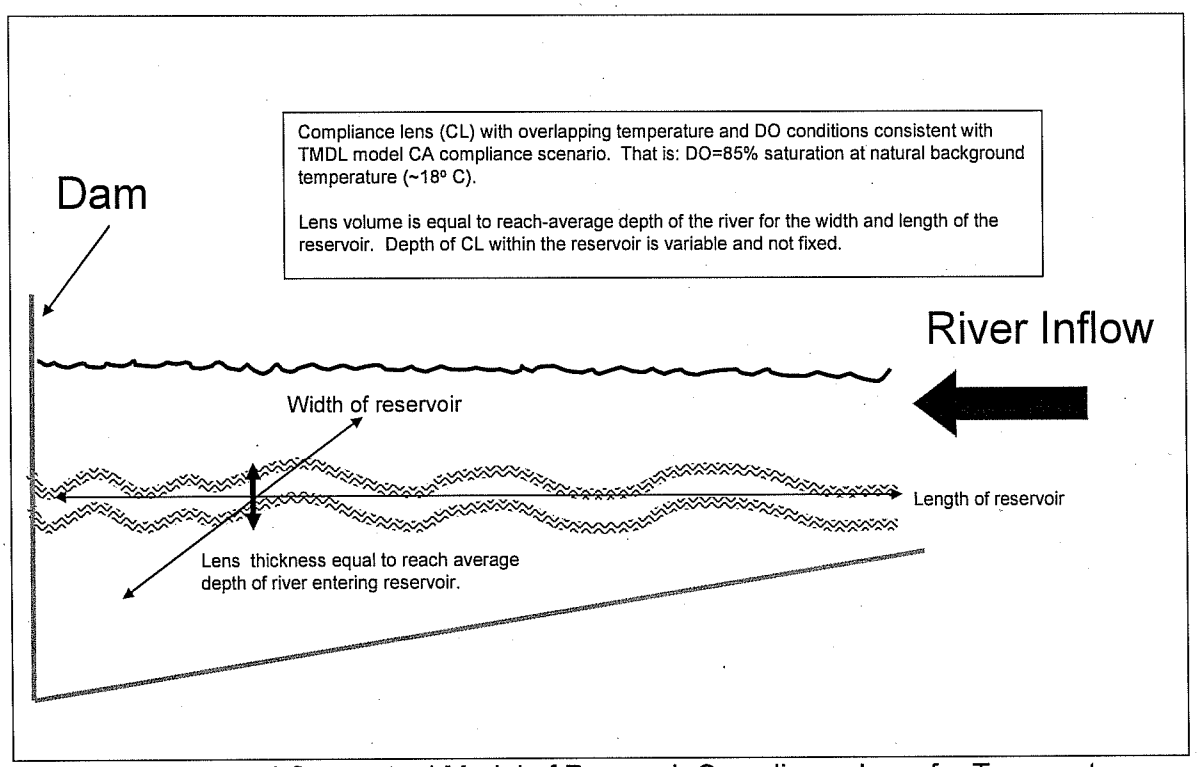

Figure 1: Illustrated Conceptual Model of Reservoir Compliance Lens for Temperature and Dissolved Oxygen.

The allocation is for the critical period of May through October and requires overlapping DO concentrations consistent with 85% saturation, at temperatures consistent with natural water temperatures at the point of entry to the reservoirs within a lens throughout the reservoir.

The volume of each reservoir compliance lens is equal to the average hydraulic depth of the river in a free-flowing state for the width and length of the reservoir. The depth at which the compliance lens occurs within the reservoirs will vary. For Copco 1 and 2 and Iron Gate Reservoirs the instantaneous DO mass that achieves the DO allocation equals 39,398 pounds (7.64 mg/L) and 47,624 pounds (7.60 mg/L), respectively[1].

Staff requests the reviewer's assessment of the beneficial use protectiveness of this allocation.

[1] The instantaneous DO mass for Copco and Iron Gate was calculated from the depth within each reservoir at which temperatures achieved California compliance scenario temperatures. The volume within the compliance lens was calculated from the depth at which compliance is achieved to the thickness associated with the reach-average depth of the free-flowing river channel for the entire width of the reservoir at these depths. This volume estimate was then multiplied by the average 85% DO saturation concentration calculated from the California compliance scenario to get the instantaneous DO mass for each reservoir.

3. **Analysis of the effects of tributary stream flow rates on stream temperatures in the tributaries and Mainstem of the Klamath River.**

The Klamath River watershed intrastate temperature objective is a narrative objective and reads:

> The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.
> At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature.
> At no time or place shall the temperature of WARM intrastate waters be increased more than 5°F above natural receiving water temperatures.

The Basin Plan does not define natural receiving water temperatures and does not identify the factors that should be considered in quantifying natural receiving water temperatures.

The draft TMDL includes an analysis of the affects of the Klamath River dams on stream temperatures, as well as the affects of tributary stream temperatures on Klamath River temperatures. An analysis of the Shasta, Scott, and Trinity Rivers (major tributaries to the Klamath River) evaluated all controllable stream temperature related factors, including flow, as well as riparian shade, and in the case of the Shasta River – irrigation tailwater return flows.

Staff requests the reviewer's assessment of whether the Shasta, Scott, and Trinity Rivers flow-temperature analysis is based upon sound scientific knowledge, methods, and practices.

4. **Assessing the linkage between water quality and fish disease.**

The TMDL Problem Statement conceptual model identifies linkages between water quality conditions and the increasing prevalence of fish disease in the Klamath River below Iron Gate Dam. Figure 2 below illustrates the basic concept of the combined effects of: 1) increased stress on fish populations (increased susceptibility to infection); and 2) water quality conditions that promote a higher concentration of parasite spores in the water column increasing the rate of infection in salmon populations.

The specific linkages between water quality conditions and the promotion of fish disease are illustrated in the nutrient conceptual model and described in the problem statement (Staff Report Chapter 2). A basic premise of the TMDL is that by reducing biostimulatory conditions, improving dissolved oxygen conditions, and restoring a more natural temperature regime and providing cold water refugia will result in a reduced incidence of fish disease and mortality. Improving the overall status of fish populations is the key end point to restoring many of the beneficial uses of the Klamath River. Is the linkage between water quality impairment and the impacts of fish disease on beneficial use support presented in the TMDL Staff Report based upon sound scientific knowledge, methods, and practices?

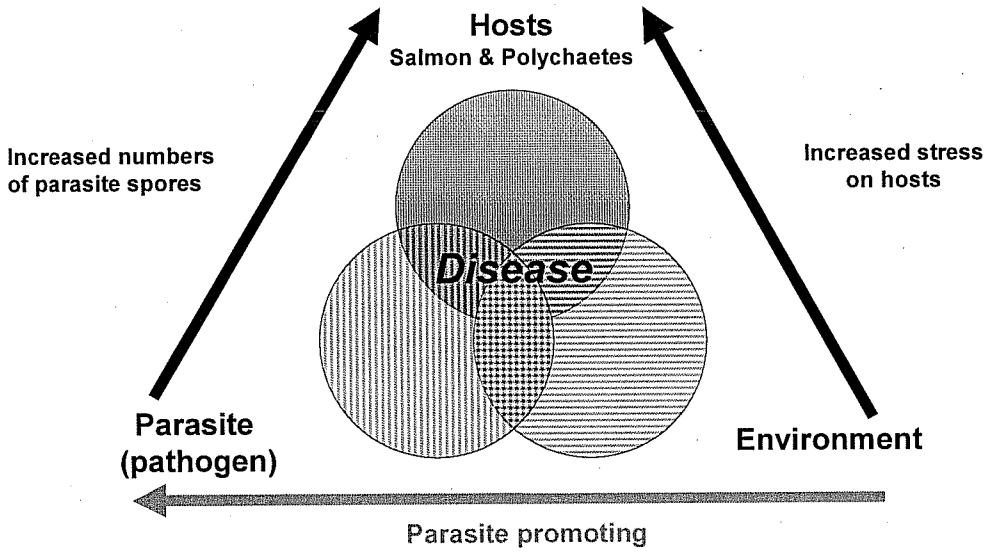

Figure 2.4: Severity of *Ceratomyxosis* in Klamath River suggests a shift in the host/ parasite balance towards *C. shasta* - Source: Bartholomew personal communication 2008

Other Issues

Reviewers are not limited to addressing only the specific issues presented above. Additionally, we invite you to contemplate the following "Big Picture" questions.

(a) In reading the technical reports and proposed implementation language, are there any additional scientific issues that should be part of the scientific portion of the proposed rule that are not described above? If so, comment with respect to the statue language given above.

(b) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirements for absolute scientific rigor. In these situations, the proposed course of action is favored over no action.

Attachment 3

List of Participants

Regional Water Board staff prepared the documents using available literature and information. In addition, outside consultants contributing to TMDL development included the following:
Tetra Tech:

Andrew Parker
Rui Zou
Mustafa Faizullabhoy
Jon Butcher

Watercourse Engineering, Inc:

Mike Deas
Sarah Null

Dr. Scott Wells, Oregon State University, provided a peer review of the water quality models applied by PacifiCorp for the Klamath; the same models applied for TMDL development.

Finally, the following professors from Humboldt State University are working under contract with the State Water Resources Control Board on a Klamath Basin Water Quality Monitoring Coordination Group contract, which incorporates elements of the Klamath TMDL:

Steve Steinberg
Andrew Stubblefield
Terry Uyeki